

WHAT WE CLAIM IS:

1. A variable transmission window assembly suitable for use as an architectural or vehicular glazing:
  - a first glass substrate having a first transparent conductor coated surface;
  - a second glass substrate having a second transparent conductor coated surface, said second substrate positioned in substantially parallel spaced-apart relationship with said first substrate and with said first and second conductor coated surfaces facing each other;
  - an electrochromic medium disposed between said first and second substrates whereby the transmission of light through said electrochromic medium is changed when an electrical potential is applied thereto and wherein said electrochromic medium comprises a plasticized, cross-linked polymeric solid film formed by curing an electrochromic monomer composition that includes at least one polyfunctional component capable of cross-linking, at least one anodic electrochromic compound, at least one cathodic electrochromic compound and a plasticizer.
2. The window assembly of claim 1, wherein said glazing exhibits reduced hydrostatic pressure when vertically mounted.
3. The window assembly of claim 2, wherein said glazing is a window for a home or an office.
4. The window assembly of claim 2, wherein said glazing is a windshield, side window, blacklight, visor or shadefband for a vehicle.
5. The window assembly of claim 1, wherein said polyfunctional component comprises a polyfunctional hydroxy compound.

6. The window assembly of claim 5, wherein said hydroxy compound comprises a glycol or a glycerol.

7. The window assembly of claim 5, wherein said hydroxy compound comprises a triol.

8. The window assembly of claim 1, wherein said polyfunctional component comprises a polyfunctional amino compound or a polyfunctional mercapto compound.

9. The window assembly of claim 8, wherein said amino compound comprises a primary amino compound or a secondary amino compound.

10. The window assembly of claim 1, wherein said polyfunctional component has a functionality of 2 or greater.

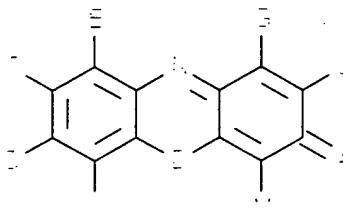
11. The window assembly of claim 1, wherein said plasticizer comprises a member selected from the group consisting of acetonitrile, benzylacetone, 3-hydroxypropionitrile, methoxypropionitrile, 3-ethoxypropionitrile, propylene carbonate, ethylene carbonate, glycerine carbonate, 2-acetylbutyrolactone, cyanoethyl sucrose,  $\gamma$ -butyrolactone, 2-methylglutaronitrile, N,N'-dimethylformamide, 3-methylsulfolane, methylethyl ketone, cyclopentanone, cyclohexanone, 4-hydroxy-4-methyl-2-pentanone, acetophenone, glutaronitrile, 3,3'-oxydipropionitrile, 2-methoxyethyl ether, triethylene glycol dimethyl ether and combinations thereof.

12. The window assembly of claim 1, wherein at least one of said first and second transparent conductor coated surfaces is coated with a transparent conductor comprising one of indium tin oxide, doped tin oxide and doped zinc oxide.

13. The window assembly of claim 12, wherein said transparent conductor may be selected from the group consisting of indium tin oxide, indium tin oxide full wave, indium tin oxide half wave, indium tin oxide half wave green, tin oxide, antimony-doped tin oxide, fluorine-doped tin oxide, antimony-doped zinc oxide and aluminum-doped zinc oxide.

14. The window assembly of claim 1, wherein said electrochromic medium comprises at least one of an ultraviolet stabilizer, a humectant, a coloring agent, a spacer, a flame retarding agent, a heat stabilizing agent, an antioxidantizing agent, a lubricating agent, a compatibilizing agent, an adhesion promoting agent and a coupling agent.

15. The window assembly of claim 1, wherein said anodic electrochromic compound comprises a member selected from the class of chemical compounds represented by the following formulae:



I

wherein A is O, S or NRR<sub>1</sub>;

wherein R and R<sub>1</sub> may be the same or different and each may be selected from the group consisting of H or any straight- or branched-chain alkyl constituent having from about one carbon atom to about eight carbon atoms, provided that when A is NRR<sub>1</sub>, Q is H, OH or NRR<sub>1</sub>;

D is O, S, NR<sub>1</sub> or Se;

E is R<sub>1</sub>, COOH or CONH<sub>2</sub>;

G is H;

J is H, any straight- or branched-chain alkyl constituent having from about one carbon atom to about eight carbon atoms,  $\text{NRR}_1$ ,  $\text{NR}_1\text{CR}_1$ ,  $\text{OR}_1$ , phenyl, 2,4-dihydroxyphenyl or  $\text{O}=\text{O}$

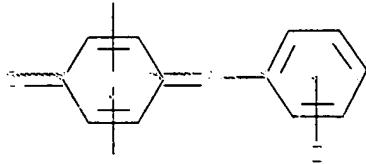
any halogen; or G and J, taken together, represent an aromatic ring structure having six carbon ring atoms when viewed in conjunction with the ring carbon atoms to which they are attached;

L is H or OH;

M is H or any halogen;

T is  $\text{R}_1$ , phenyl or 2,4-dihydroxyphenyl; and

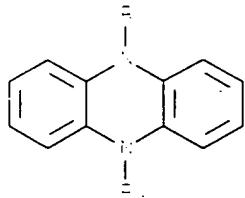
Q is H, OH or  $\text{NRR}_1$ ; provided that said anodic electrochromic compound I has been previously contacted with a redox agent;



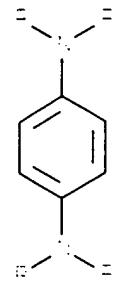
II

wherein X and Y may be the same or different and each may be selected from the group consisting of H, any halogen and  $\text{NRR}_1$ , wherein R and  $\text{R}_1$  may be the same or different and each may be selected from the group consisting of H or any straight- or branched-chain alkyl constituent having from about one carbon atom to about three carbon atoms; or, X and Y, taken together, represent an aromatic ring structure having six carbon ring atoms when viewed in conjunction with the ring carbon atoms to which they are attached; and

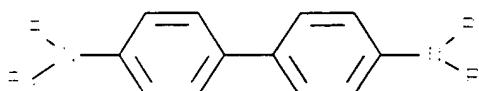
Z is OH or NRR<sub>1</sub>, or salts thereof; provided that said anodic electrochromic compound II has previously been contacted with a redox agent;



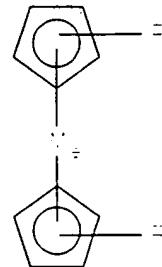
III



IV

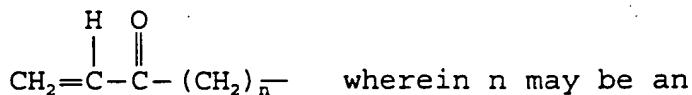


V



VI

wherein R and R<sub>1</sub> may be the same or different, and each may be selected from the group consisting of H; any straight- or branched-chain alkyl constituent having from about 1 carbon atom to about 8 carbon atoms; acetyl; vinyl; allyl; -(CH<sub>2</sub>)<sub>n</sub>-OH, wherein n may be an integer in the range of 0 to about 20;



integer in the range of 0 to about 20;  
-(CH<sub>2</sub>)<sub>n</sub>-COOR<sub>2</sub>, wherein n may be an integer in the range of 0 to about 20

and R<sub>2</sub> may be any straight- or branched-chain alkyl constituent having from about 1 carbon atom to about 20 carbon atoms, hydrogen,

$\begin{array}{c} \text{CH}_3 \\ | \\ \text{C}=\text{O} \\ | \\ \text{CH}_2=\text{C}-\text{C}-\text{O}-\text{(CH}_2\text{)}_n-\end{array}$  or

$\begin{array}{c} \text{H} \\ | \\ \text{C}=\text{O} \\ | \\ \text{CH}_2=\text{C}-\text{C}-\text{O}-\text{(CH}_2\text{)}_n-\end{array}$ , wherein n may be an

integer from 0 to about 20,  
 $-\text{(CH}_2\text{)}_{n'}-\text{OR}_3$ , wherein n' may be an integer in the range of 1 to about 12 and R<sub>3</sub> may be any straight- or branched-chain alkyl constituent having from about 1 carbon atom to

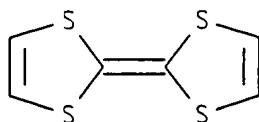
about 8 carbon atoms,  $-\text{C}=\text{O}-\text{CH}=\text{CH}_2$ ,

$\begin{array}{c} \text{O} \quad \text{CH}_3 \\ | \quad | \\ \text{C}=\text{C}=\text{CH}_2 \end{array}$ , and  $-\text{(CH}_2\text{)}_{n'}-\text{N}^+(\text{CH}_3\text{)}_3\text{X}^-$ ,

wherein n' may be an integer in the range of 1 to about 12;

wherein X may be selected from the group consisting of Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, PF<sub>6</sub><sup>-</sup>, ClO<sub>4</sub><sup>-</sup> and BF<sub>4</sub><sup>-</sup>;

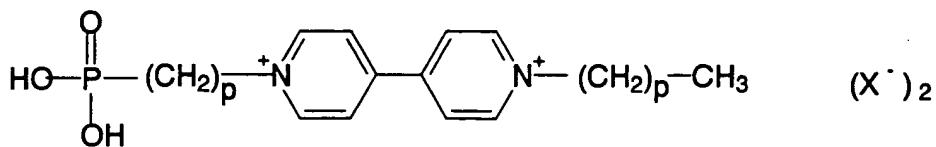
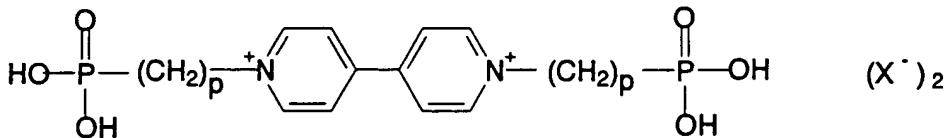
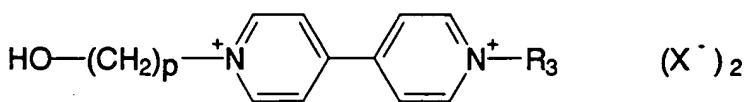
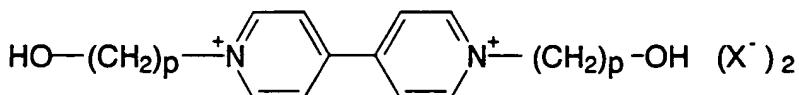
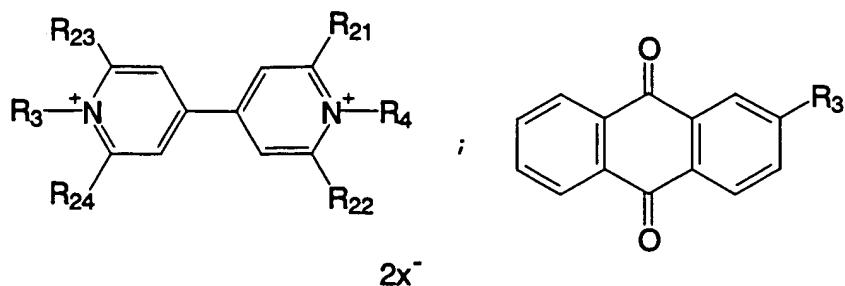
wherein M<sub>e</sub> is selected from the group consisting of Fe, Ni, Ru, Co, Ti, Cr, W, and Mo;



VII

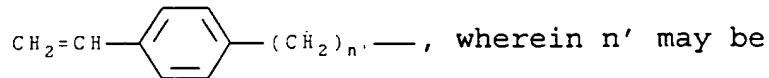
and combinations thereof.

16. The window assembly of claim 1, wherein said cathodic electrochromic compound comprises a member selected from the group of chemical compounds consisting of the following chemical formulae:

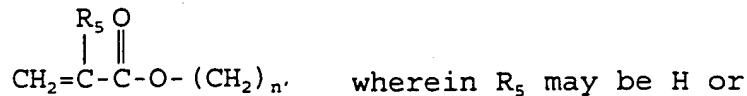


wherein  $R_3$ ,  $R_4$ ,  $R_{21}$ ,  $R_{22}$ ,  $R_{23}$  and  $R_{24}$  may be the same or different and each may be selected from the group consisting of H, any straight- or branched-chain alkyl constituent having from about one carbon atom to about eight carbon atoms, or any straight- or branched-chain alkyl- or alkoxy-phenyl, wherein the alkyl

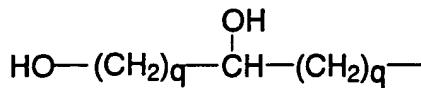
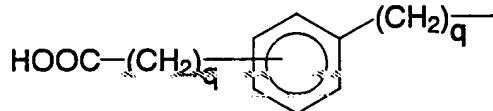
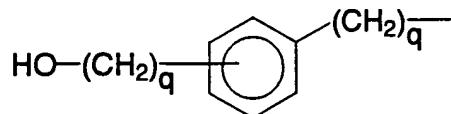
or alkoxy constituent contains from about one carbon atom to about eight carbon atoms;



an integer in the range of 1 to 12;



$\text{CH}_3$ , and  $n'$  may be an integer in the range of 1 to 12;  $\text{HO-}(\text{CH}_2)_{n'}-$ , wherein  $n'$  may be an integer in the range of 1 to 12; and  $\text{HOOC-}(\text{CH}_2)_{n'}-$ , wherein  $n'$  may be an integer in the range of 1 to 12;



wherein  $q$  may be an integer in the range of 0 to 12; wherein each  $p$  is independently an integer from 1 to 12; wherein  $X$  is selected from the group consisting of  $\text{BF}_4^-$ ,  $\text{ClO}_4^-$ ,  $\text{CF}_3\text{SO}_3^-$ , styrylsulfonate ("SS<sup>-</sup>"), 2-acrylamido-2-methylpropane-sulfonate, acrylate, methacrylate, 3-sulfopropylacrylate, 3-sulfopropylmethacrylate,  $\text{PF}_6^-$ ,  $\text{Ac}^-$ ,  $\text{HO-}(\text{R}_{25})-\text{SO}_3^-$  and  $\text{HOOC-}(\text{R}_{25})-\text{SO}_3^-$  wherein  $\text{R}_{25}$  can be any

straight- or branched-chain alkyl constituent having from about 1 carbon atom to about 8 carbon atoms, an aryl or a functionalized aryl, an alkyl or aryl amide, a branched or linear chain polymer, any halide; and combinations thereof.

17. The window assembly of claim 1, wherein said cathodic electrochromic compound may be selected from the group consisting of ethylviologen perchlorate, heptylviologen styryl sulfonate, distyrylmethyl viologen perchlorate, ethylhydroxypropyl viologen perchlorate and combinations thereof.

18. The window assembly of claim 15, wherein said anodic electrochromic compound III is 5,10-dihydro-5,10-dimethylphenazine.

19. The window assembly of claim 15, wherein said anodic electrochromic compound VI is ferrocene.

20. The window assembly of claim 1, wherein said curing of said electrochromic monomer composition is an in-situ cure after said monomer composition has been disposed between said first and second substrates.

21. The window assembly of claim 1, wherein said glazing has a transmission in an unpowered state of at least 60% of light incident thereon.

22. The window assembly of claim 1, wherein said glazing has a transmission less than 10% of light incident thereon when an electrical potential of 1.3 V is applied to said electrochromic medium.

23. The window assembly of claim 1, wherein said glazing is a large area glazing of an area of at least 99 square inches.

24. The window assembly of claim 1, wherein at least one of said first and second glass substrates comprises a specialized glass with reduced ultraviolet radiation transmission.

25. The window assembly of claim 1, wherein at least one of said first and second glass substrates comprises tinted glass.

26. The window assembly of claim 25, wherein said tinted glass is one of a blue tinted glass and a gray tinted glass.

27. The window assembly of claim 14, wherein said electrochromic medium comprises an ultraviolet stabilizer in an amount, by weight, of about 0.1% to 15%.

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